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PATENT SPECIFICATION

DRAWINGS ATTACHED

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COMPLETE SPECIFICATION

Improvements in or relating to Apparatus for Separating Metallic Substances from Non-Metallic Material

We, FARBWERKE HOECHST AKTIENGESELLSCHAFT vormals Meister Lucius & Brüning, a Body Corporate recognised under German Law, of (16) Frankfurt (M)-Hoechst, Germany, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

This invention relates to apparatus for separating metallic substances from moving non-metallic material. In particular the apparatus may be used for separating metallic substances from moving non-metallic material which is to be ground.

One known form of such apparatus comprises a vertical shaft around the upper portion of which is wound a coil connected to a high-frequency vacuum-tube oscillator. Material to be ground is fed into the top of the shaft, passes through the high-frequency alternating field of the oscillator coil and emerges at the bottom of the shaft. The lower end of the shaft has a deflecting flap actuable by an amplifier to deflect material from passing to the grinding apparatus. The amplifier comprises rectifying and differentiating means and includes components having time constants corresponding to the time taken for material to pass through the coil and reach the deflecting flap.

When any metallic substance, whether ferro-magnetic or not, which may be present in the material to be ground, passes through the oscillator coil, the amplitude and frequency of the oscillations generated by the oscillator are modified and an impulse-like alteration of the anode current of the oscillator tube is caused. This alteration in anode current results in a transient voltage which is rectified and differentiated in the amplifier and the flap at the bottom of the shaft is actuated to deflect material from passing to the grinding apparatus. The amplifier components having time-constants corresponding to the time taken for material to pass through the oscillator coil and reach the deflecting flap, delay actuation of the flap so that only that portion of the material passing through the oscillator coil which results in a substantial modification of the amplitude and frequency of oscillation of the oscillator is deflected at the lower end of the shaft. When metallic substance has ceased to pass through the oscillator coil the deflecting flap, after the appropriate delay, returns to its normal unoperated position and material again passes to the grinding apparatus.

A typical oscillogram of the transient voltage referred to above, and produced in the apparatus just described, when a metallic substance passes through the oscillator coil, is illustrated in Fig 1 of the accompanying drawings which shows the voltage after amplification and delay. The transient impulse comprises a fundamental oscillation having a frequency lower than 50 c/s together with various harmonic oscillations, the amplified pulse shown in Fig. 1 having been lengthened by about twenty times. A 50 c/s oscillation represents a large portion of the impulse and when the impulse is amplified any mains disturbing voltage of 50c/s induced in the oscillator coil will also be amplified. A disadvantage of this form of apparatus is that compensation in the amplifier of this 50 c/s disturbing voltage weakens the transient impulse resulting from passage of a metallic substance through the oscillator coil. Other high frequency voltages introduced via the

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oscillator coil can be filtered out in the amplifier since their frequency is substantially higher than that of the transient voltage resulting from passage of metallic material through the oscillator coil.

The passage of a large batch of non-metallic material through the coil can also produce a transient voltage so that this form of apparatus has a further disadvantage in that the deflecting flap is liable to be actuated by non-metallic material.

The present invention provides apparatus for separating metallic substances from moving non-metallic material which does not have these disadvantages. The apparatus comprises a plurality of shafts disposed side-by-side and through which, in use of the apparatus, material passes, a coil wound around one shaft being counter-connected with any spaced apart in an axial direction from a coil wound around an adjacent shaft, the coils forming part of a high-frequency oscillator circuit, and operatively associated with the oscillator an amplifier for actuation of a device for deflecting the normal flow of material through the shafts, the amplifier including rectifying and differentiating means and including components having a time constant corresponding to the time taken by material to pass through a coil and reach the deflecting device, the arrangement being such that only passage of a metallic substance through the coils results in actuation of the deflecting device.

When the apparatus comprises more than two shafts with coils wound around them, then the coils are counterconnected in pairs. In this way any external disturbing voltage induced in the coils is balanced out without the high frequency field of the oscillator being weakened. The coils may be wound in the same sense around the shafts and the head end of the first coil of a pair connected to the tail end of the second coil of the pair and, conversely, the tail end of the first coil of the pair connected to the head end of the second coil of the pair. This results in balancing out of any external disturbing field.

Also in this apparatus, the material is distributed between the shafts and since the coils on the shafts are spaced apart in an axial direction any transient impulses formed by batch wise introduction of non-metallic material into the apparatus are produced one after the other with respect to time. The amplitude of each of these impulses is substantially smaller than the amplitude of the impulse that is produced if the whole batch of material is passed through one shaft, and the deflecting flap is therefore not actuated. Advantageously the coils of each pair of shafts are spaced apart by a distance of at least the width of a coil.

An example of apparatus embodying the invention will be described in greater detail with reference to the accompanying drawing in which:—

Fig. 2 shows the apparatus in a diagrammatic manner, and

Fig. 3 shows a portion of Fig. 2 on an enlarged scale, magnetic fields associated with oscillator coils forming part of the apparatus being indicated.

The apparatus comprises two shafts 2, 2¹ located side-by-side and having a common inlet 1 for introduction of material into the shafts 2. Two coils 3 and 4 are wound around the respective shafts 2 and 2¹, the coils forming part of a high-frequency oscillator 5. The coils 3 and 4 are wound around the shafts 2 and 2¹ in the same sense, upper and lower ends of coil 3 being connected to the lower and upper ends respectively of coil 4, as seen in the Figure. The coils 3 and 4 are spaced apart in an axial direction on the shafts 2 and 2¹, by a distance of at least the width of a coil. Coupled to the oscillator 5 is an amplifier (not shown) connected to means for actuating a deflecting device (not shown) arranged at the outlet of the shafts 2 and 2¹ and which device serves, when actuated, to deflect the normal flow of material from the outlet. The amplifier includes rectifying and differentiating circuits and includes also components having a time constant equal to the time taken for material to pass through one of the coils 3 or 4 and reach the deflecting device.

High-frequency fields are indicated at 6 and 7 Fig. 3. The coils 3 and 4 have equal dimensions and comprise equal numbers of turns. Thus, in use of the apparatus, the voltages U1—U2 and U3—U4 due to an external field, e.g. due to an adjacent 50 c/s power supply, are equal in magnitude and opposite in phase and therefore cancel each other out.

Since the coils 3 and 4 are spaced apart in an axial direction the transient impulses induced in the coils due to passage of a metallic substance through the coils will not cancel each other out. The transient current fed to the amplifier from the oscillator will in these circumstances comprise two consecutive impulses having opposite phases.

After rectification and differentiation of the transient impulses in the amplifier, if the impulses have a sufficient amplitude, as determined by the components in the amplifier, then the deflecting device is actuated after the appropriate delay and the material passing through the outlet of shafts 2 and 2¹ is deflected until passage through the coils 3 and 4 of material containing metallic substance ceases.

WHAT WE CLAIM IS:—

1. Apparatus for separating metallic substances from moving non-metallic material,

the apparatus comprising a plurality of shafts disposed side-by-side and through which, in use of the apparatus, material passes, a coil wound around one shaft being counter-connected with and spaced apart in an axial direction from a coil wound around an adjacent shaft, the coils forming part of a high-frequency oscillator circuit, and operatively associated with the oscillator an amplifier for actuation of a device for deflecting the normal flow of material through the shafts, the amplifier including rectifying and differentiating means and including components having a time constant corresponding to the time taken by material to pass through a coil and reach the deflecting device, the arrangement being such that only passage of a metallic substance through the coils results in actuation of the deflecting device.

2. Apparatus as claimed in claim 1 in which each coil is spaced apart, in an axial direction, from the coil with which it is counter-connected by a distance of at least the width of a coil.

ABEL & IMRAY,
Chartered Patent Agents,
Quality House, Quality Court,
Chancery Lane, London, W.C.2.

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1 SHEET *This drawing is a reproduction of the Original on a reduced scale*

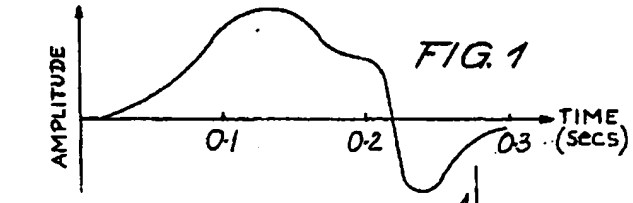

FIG. 1

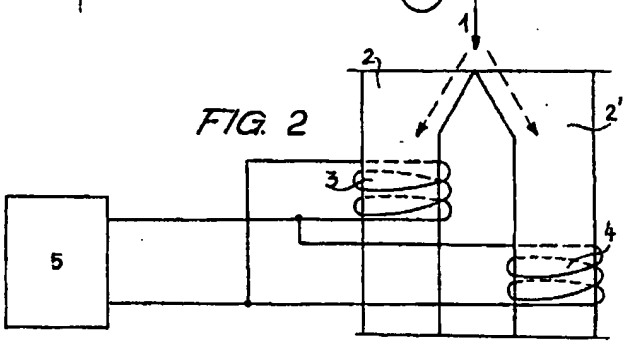

FIG. 2

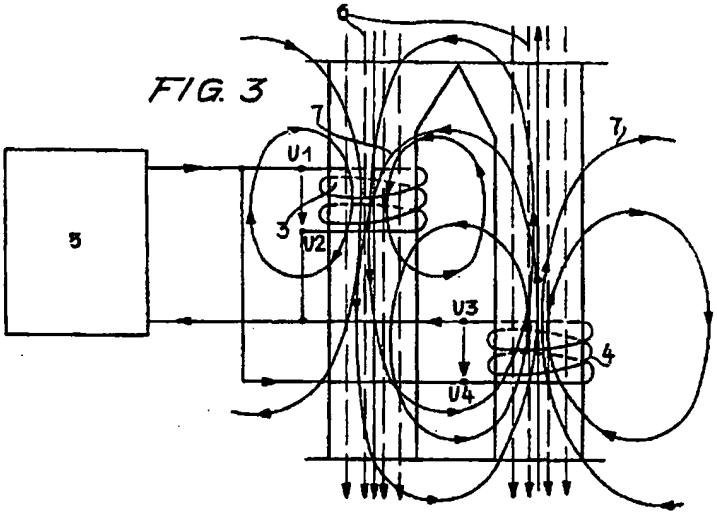

FIG. 3